Memorandum

TETRA TECH, INC.
1230 Columbia Street, Suite 520
San Diego, CA 92101
Telephone (619) 525-7014
Fax (619) 232-2392

date: May 14, 2004

from: John Craig, Tetra Tech, Inc.

phone: 619-525-7018

to: Lisa McCann and Dominic Roques, Central Coast Regional Water Quality Control Board

re: Review of Sediment Assessment and Monitoring Program (SAMP) method

cc:

The Central Coast Regional Water Quality Control Board requested support in reviewing their Sediment Assessment and Monitoring Program (SAMP) method. Specifically, advice and comments were requested on:

1. Clarifying the intent of the program,
2. Determining whether the strategy for developing the program is appropriately scaled to the problems of sedimentation in the region,
3. Identifying and clearly defining specific products of the program,
4. Establishing the utility of the program for developing 305(b) assessments, 303(d) listings, TMDL development, and for conducting surveillance and investigations pursuant to regulatory programs, and
5. Phasing of the work.

The SAMP document forwarded to us for review is a plan of work entitled "Module 4, Phase I – Project: Protocol Development" with accompanying appendices. This constitutes part of one of six modules proposed for the SAMP. The Phase I portion of Module 4 "seeks to develop a portion of this component by refining and field-testing protocols." A brief outline of all six modules of the SAMP was also attached to the Module 4, Phase I plan of work. We have provided preliminary comments based on the information provided, but we acknowledge that our understanding of the SAMP may be incomplete.

1. Clarifying the intent of the program

Clean sediment issues – and particularly the effect of altered sedimentation regime on aquatic habitat – are a major source of impairment of aquatic life in California streams. RB 3 is to be commended for taking the initiative to address these problems in an organized way.

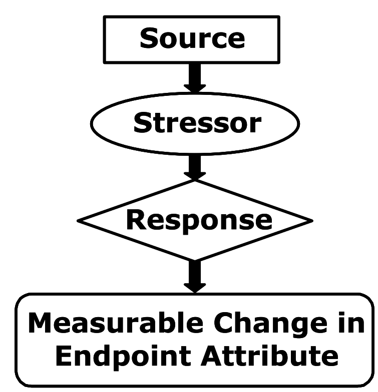
The introduction to Module 4 states that "[a] chief objective of the program is to provide tools to develop a clear definition of the sediment problems affecting water quality throughout the Region." The details for achieving this objective are not discussed in detail in the Module 4, Phase I document, and perhaps this is not the appropriate place. Instead, the focus is on testing specific monitoring protocols. While the set of protocols appears reasonable, a better clarification of intent would be desirable, whether in the introduction to this module or in a more general document.

Page 2 of the Module 4, Phase I document states "[t]he purpose of this project is to evaluate protocols that, 1) describe sediment conditions supportive of anadromous fish in the region, and 2) can be used for assessing erosion and sedimentation during site investigations, inspections, and surveillance." This makes sense, but it may be premature to test specific protocols before completing the bigger picture analysis of why specific protocols are needed.

We suggest that the RB consider justifying and organizing the SAMP in the larger context established in USEPA's 1998 *Guidelines for Ecological Risk Assessment*, which are closely compatible (despite some differences in terminology) with recommendations in USEPA's 1999 *Protocol for Developing Sediment TMDLs*. Specifically, it would be useful to frame the SAMP and clarify its intent using the Problem Formulation elements (conceptual model, risk hypotheses, assessment endpoints, and measures of effect) of Ecological Risk Assessment. This starts with the identification of goals or objectives (e.g., provide habitat that supports an anadromous fishery), evaluates the relationship between achieving these goals and stressor sources (e.g., sediment loading or hydraulic modification of channels), and only then determines appropriate surrogate measures (indicators and targets) that are useful to evaluating the risk of stressors to goals. Thus, specific protocols should arise from the evaluation of decision needs, and it may be premature to begin the SAMP with testing of protocols.

A key component of Ecological Risk Assessment is the development of a conceptual model and associated risk hypotheses. The conceptual model consolidates available information on ecological resources, stressors, and effects and describes, in narrative and graphical form, relationships among human activities, stressors, and the effects on valued ecological resources. Developing the conceptual model provides a forum for discussion, a framework for understanding and explaining the hypothetical relationships and the scope of assessments, and a structure for the forthcoming analyses. Another advantage of developing a conceptual model is that it elucidates cascading or secondary effects that may not otherwise be immediately apparent.

Elementary Conceptual Model



The conceptual model can also serve as a valuable integrating summary of existing conditions, existing and potential future threats, and management opportunities. These models often may evolve as a better understanding of sources, stressors and pathways is acquired. As a result, a conceptual model should not be viewed as a fixed product of the risk assessment but rather a conceptual "map" that will perhaps change as analyses are performed and uncertainties established during the assessment.

Initial efforts at producing a conceptual model may result in a highly complex set of pathways and linkages. The process of thinking through all these linkages can be a valuable exercise. However, it is probably neither necessary nor desirable to present an extremely comprehensive model to those who are not technical experts. Therefore, it is important to define what are thought to be the "major" sources and stressors and their relationships to assessment endpoints. Graphically, this is equivalent to identifying the most significant pathways through the conceptual model. These pathways represent the significant risk hypotheses. Both the conceptual model and hypotheses testing ideas are consistent with information presented in the Impaired Waters Guidance.

A risk hypothesis describes a single hypothesized relationship between a particular stressor (or management action on a stressor) and a management objective. The conceptual model, typically displayed as a flow chart, aggregates risk hypotheses to display all the linkages from stressors to assessment endpoints. Each pathway within the network of a conceptual model constitutes a risk hypothesis. For instance, a risk hypothesis that (1) grazing activities lead to destabilization of upland soils, (2) resulting in increased loading of fine sediment to the stream, (3) resulting in filling of natural pools with fines, (4) resulting in lack of pool refuge habitat to support resident fish, is one among many risk hypotheses that can be expressed by the linkages contained in a conceptual model.

Assessment of risk involves a valuation of assessment endpoints, using observations and/or predictions. Evaluating the relative efficacy of management options typically involves a prediction of the response of an assessment endpoint to the management intervention. But, assessment endpoints themselves are not easily measured, and the response of assessment endpoints to changing conditions is often difficult to predict. For instance, an assessment endpoint for risk assessment of a fishery might be spawning success of salmonids. This is difficult to measure directly at the watershed scale, although associated information, such as count of young-of-year in samples, may be obtainable.

Instead of measuring and predicting responses of the assessment endpoint directly it is often necessary to identify surrogates or *measures of effect* that can stand in for the assessment endpoint. Measures of effect are measurable changes in an attribute of an assessment endpoint or its surrogate in response to a stressor to which it is exposed. Measures of effect represent key nodes along the pathways in the conceptual model at which the flow of impacts from stressors to objectives can be quantified.

Meaningful measures of effect should have the following characteristics:

- Link objectives to stressors (and changes in stressors) and thus correspond to a risk hypothesis defined in the conceptual model.
- Sensitive to changes in condition of the objective
- Reflect susceptibility to individual stressors
- Are meaningful to decision-makers
- Are measurable, or at a minimum subjectively rankable
- Can be predicted in response to management options

Within the context of the SAMP, specific monitoring protocols can be seen as measures of effect. The specific measures under consideration can all be justified from this perspective – refer to the section on “Identification of Water Quality Indicators and Target Values” in the *Protocol for Developing Sediment TMDLs*. Phase I of Module 4 is focused only on support of anadromous fish. In this context, the outline shows the proper focus. For instance, (1)(c) proposes evaluating protocols for “capacity to yield analytical evidence of sediment effects on salmonids.” Thus, the protocols are indeed being evaluated as potential measures of effect to evaluate a risk hypothesis. This intent might be better clarified by beginning from the risk assessment perspective. All this is potentially covered in Module 2 of the SAMP.

2. ***Determining whether the strategy for developing the program is appropriately scaled to the problems of sedimentation in the region.***

Limited information is available to answer this question. However, the outline of the SAMP appears to provide the framework for a comprehensive strategy to address sedimentation problems in the region at a variety of scales. The proposed outline reflects a hierarchical scaling, from a general consideration of sediment-associated problems in Module 2, to a regional evaluation of sediment problems in Region 3 in Module 3, and site-specific monitoring in Module 4. The proposed plan for Phase I includes a good representative sample of different types of sites of interest. Planning for data management of both measurement and spatial data is already under way, which is a definite asset. The only suggestion we have is to proceed as soon as possible with further development of Modules 2 and 3 with an eye to determination of proper scales of evaluation associated with different types of sediment problems in the region.

3. ***Identifying and clearly defining specific products of the program.***

The specific products of the program are clearly defined in the overall outline. What is less clearly defined at this point is how the specific products fit into various regulatory commitments of RB 3 (item 4).

4. ***Establishing the utility of the program for developing 305(b) assessments, 303(d) listings, TMDL development, and for conducting surveillance and investigations pursuant to regulatory programs.***

The proposed work will clearly support the whole range of regulatory programs associated with evaluating and maintaining aquatic life support. However, the outline provided contains only brief placeholders on this topic (e.g., Module 1 will address relationship to existing programs, Module 2 will address criteria for evaluating beneficial uses, etc.). For the overall SAMP, it may be advisable to add a Module 7 that will explicitly address use of SAMP products in specific regulatory contexts, as well as referring to appropriate complementary guidance (such as the *Protocol for Developing Sediment TMDLs*).

For the specific items covered in Phase I of Module 4, the context needs to be provided to better justify the potential use of the protocols being tested. Numerous examples could be cited, for instance, of the use of these protocols in the completion of sediment TMDLs (for example, the Garcia River and South Fork Trinity TMDLs) or watershed management efforts for other sediment-impacted watersheds in California, such as Salinas River.

5. ***Phasing of the work.***

As noted above, the protocols being tested in Phase I of Module 4 are appropriate. However, it would seem advisable to pursue at least initial development of Module 2 – which provides the justification of these efforts – as soon as is possible.

Regarding the phasing of the Phase I work, only a limited subset of the proposed protocols will be tested at this time. This probably reflects staffing availability. The selection for the first phase in general appears appropriate. However, it might be cost-effective to include some V* measurements within Phase I as well.

Notes on Phase I Protocols

The text states that "full versions" of the protocols are "found in the appendices." The appendices, however, vary in completeness, and no protocol was provided for embeddedness. Several of the methods were adopted from Sotoyome Resource Conservation District, from which more detailed descriptions may be available. Only the McNeill and Photomonitoring protocols appear to be described in adequate detail at this time.

The discussion of the McNeill Bulk Sampling is detailed and cited as "adapted from Rex and Carmichael, 2002", although the full reference is not given. The equipment list shows what sieves (size fractions) will be evaluated. The sieve set does not include 0.85 and 6.4 mm, which have commonly been used as breakpoints in sediment TMDL evaluations. It would seem that these sizes might be included (instead of 1 and 6.3 mm) for comparability to other studies. Post-sampling data analysis is not discussed, but it would seem advisable to specify a graphical or statistical method for estimating the d_{50} from the data, as this is another commonly used indicator in sediment TMDLs.

No protocol was provided for the embeddedness procedure. This measure has a somewhat mixed history of success. In general, embeddedness has been thought to be appropriate to gravel bed streams, but of less value in determining habitat quality in sandy streams and low-gradient warm-water fishery streams. Replicability of embeddedness measures obtained at a single site has also been a problem (*Protocol for Developing Sediment TMDLs*, p. 4-8).

For all three active bed matrix measures, it would be desirable to do some further work on precision and replicability in RB 3 streams. Only when the uncertainty associated with an individual measure is known is it possible to determine the weight that should be placed on an interpretation derived from that measure. The McNeill and Pebble Count procedures do contain a discussion of replicability and bias, with QA/QC recommendations. This component is important and should be pursued.

The protocol for Visual Channel Inspections is not clearly defined in the text. The appendix consists of a single page outline, stating that it is adapted from Watson et al. 2003 (WI-2003-06) from the Watershed Institute at Cal State Monterey. We took a quick look at this lengthy document online, which is a report for the Salinas Sediment TMDL, and did not see that a protocol for visual inspections is clearly described therein. As presently described, the visual inspections protocol is qualitative and vague. The Region should probably start from the basis of a tested and clearly defined visual inspection method (for example, one such as the NRCS [1999] *Stream Visual Assessment Protocol*) that provides explicit instructions and standardized recording forms and scoring criteria.